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E. H. JONES, Commissioner

No. 35

Important Tree Insects

OF

VERMONT

BY

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In charge of Insect Suppression



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CONTENTS

INTRODUCTION

Insects in General

Stages of Life.....	3
Eggs.....	4
Larvae.....	4
Molting.....	4
Pupae.....	4
Adult.....	4
Metamorphosis, Complete and Incomplete.....	4
Chewing and Biting Insects.....	5

Insect Control Measures

Pruning and Cutting.....	5
Destroying eggs, etc.....	5
Spraying.....	7-10
Banding etc.....	10

Leaf Eating Insects

Gypsy Moth.....	12-15
Tent Caterpillars.....	15-18
Canker Worms.....	18-22
Lime-tree Winter Moth.....	22
Elm Leaf Beetle.....	22-25
Saddled Prominent.....	25
Green-Striped Maple Worm.....	26
Birch-Leaf Skeletonizer.....	28
Brown-tail Moth.....	30-32
Spiny Elm Caterpillar.....	32
Tussock Moths.....	32-34
Elm Leaf Miner.....	34
Maple Leaf Cutter.....	34-35
Arbor Vitae Leaf Miner.....	35
Yellow Necked and Red Humped Apple Tree Caterpillars.....	35-36
Fall Web worm.....	36
Sawflies.....	36-38
Alder Flea Beetle.....	38
Cherry Tent Maker.....	38-39
Hickory Tiger Moth.....	39
Giant Silk Worms.....	39-40
Larch Case-Bearer.....	40-41

Sucking Insects

Aphids.....	41
Green Apple.....	41
Woolly Apple.....	42
Alder Blight.....	43
Pine Bark.....	43
Spruce Gall.....	43
Control of Aphids.....	44
Scale.....	44
Oyster-shell.....	44
San Jose.....	45
Other Scales.....	45

Boring Insects

Sugar Maple Borer.....	45
Elm Borer.....	46
Locust Borer.....	47
Maple and Oak Twig Pruner.....	48
White Pine Weevil.....	49
Round Headed Apple Tree Borer.....	50
Other Borers.....	51

IMPORTANT TREE INSECTS OF VERMONT

By HAROLD L. BAILEY

In Charge of Insect Suppression, Vermont Department of Agriculture.

INTRODUCTION

This bulletin is designed to serve as a brief handbook for the identification and control of those insects which, judged from twelve years' observation, are most prominent in their attacks upon the trees of Vermont. In a few cases the basis of importance is the unusual conspicuousness of the work of the insect in question and the alarm which its appearance in large numbers may cause rather than any great damage which it does. Several species have been included chiefly because of their fancied resemblance to certain dreaded pests like the gypsy moth.

No publication of this size, nor of many times its size, could treat of all the destructive insects to be found upon our trees. Neither is it feasible to discuss in the light of their insect enemies all of the trees of the state. The trees chiefly in the writer's mind have been those to which a program of care could reasonably be applied — such trees as are commonly used for shade and ornamental purposes, including the apple tree as well as some of our best forest trees.

In many cases the insects herein treated are representatives of groups the members of which have very similar characteristics and which may at occasional periods rise to prominence. For this reason almost any insect control measure which is carried out operates against more than the particular species for which the work is designed.

Since individual problems of insect control, beyond the scope of any generalized program, constantly arise, it is one of the purposes of the Vermont Department of Agriculture to furnish special advice and information along these lines and to make investigations wherever the occasions warrant such action. Requests for such assistance should be addressed to Commissioner of Agriculture, Montpelier, Vt.

INSECTS IN GENERAL

A general study of insect life would be found both interesting and profitable to any person having care of trees or plants, but these facts at least should be borne in mind in attempting any line of insect control work:

Stages of Life. Insects of the higher type, including moths, butterflies, beetles and flies, pass through four regular stages of life—the egg, the larva, the pupa and the adult. The length of time spent in each of these stages varies with the kind of insect, as does the total length of the life cycle.

Eggs. Eggs are deposited by the adults upon or close to the food which the progeny are to eat. They may be laid singly or in groups, under protective matter or left bare; hence, conspicuous or exceedingly inconspicuous.

Larva. The larva, which hatches from the egg, is the growing and, generally speaking, the destructive stage. In the case of the beetle it is called the grub, of the fly it is the maggot and of the moth or butterfly it is the caterpillar. And the caterpillar may be hairy and fuzzy, as is the general conception, or it may be smooth and slender and devoid of noticeable hair. In this connection, too, it should be pointed out that a caterpillar is not a worm, though that term has become attached to many moth larvae, such as the canker worm and the green-striped maple worm. A true worm is not an insect.

Molting. A curious feature of the larval growth of insects is the molting or changing of skin which is made necessary by the rapid growth of the creatures. Lacking bones, the structure of the larva is maintained by a glue-like matter called chitine which stiffens the skin. Naturally, the skin thus hardened can expand only to a certain limit and as the insect grows it has to cast off one old skin after another, at each change appearing in a fresh suit which has been developing underneath the old one. This process is called molting; and the number of molts varies according to the species. Four or five is the common number for many species. The period between molts is sometimes referred to as an instar.

Pupa. The pupa stage — represented by the chrysalis, in the case of the butterfly — is the outwardly inactive period of the insect's life in which it is transforming from the larva to the adult. To casual observation a pupa usually presents slight appearance of being a living thing, though some are able to squirm about. In many cases pupae are formed within cocoons — sacks or cases woven by the larvae; many others are in earthen cells in the soil and still others simply lie in debris of various sorts. In the case of the flies — the diptera — the cocoon usually is formed of the last larval molt skin and is called the puparium.

Adult. From the pupa comes the adult — sometimes called the imago. In most cases it is winged like the butterfly or beetle, and it is the perfect stage.

In the cases of most of the insects with which we have to deal the adult is far less troublesome than is the larva. It appears to be the chief business of the adults to mate and deposit the eggs for the succeeding generation.

Metamorphosis. The passage through these stages is called metamorphosis. Certain orders of insects have what is called incomplete metamorphosis. That is, there is no complete break between the larva or nymph, as it is called in this case, and the adult. The nymphs when they first hatch, bear a resemblance to the adults and gradually develop wings and other appendages. Grasshoppers are

illustrative of this type as are also the true bugs such as squash bugs, bed bugs, etc. Though all insects are more or less flippantly called "bugs" only those of a certain group of the sucking type are entitled to the distinction.

Certain lower species have but two real stages, for they produce living young instead of depositing eggs. Some of the scale insects are of this kind.

Chewing and Biting Insects. Aside from the scientific classification and grouping of insects there is the practical division which puts the greater part of the nearly four hundred thousand known species of insects into one or the other of two groups; those which take their nourishment by biting out, chewing and swallowing pieces of their food and those which attain the same ends by sucking their food through tubes: thus, the chewing insects and the sucking insects. Knowledge as to the proper assignment of an insect within these two classes is of supreme importance in planning its control.

INSECT CONTROL MEASURES

There are many methods of insect control applying to their various types and their work, but for practical purposes three general measures commend themselves for the artificial control of most of the insects considered in the following pages.

Pruning and Cutting. The first is the cutting and immediate burning of worthless growth, whether it be whole trees past their usefulness, or branches, or twigs of trees which simply require pruning. This is particularly applicable to apple trees for they are favorites with an extra large number of insect pests, and there is an extra large number of apple trees many of which are either wholly valueless or require a huge amount of pruning to make them of any worth. Others might (by pruning and cultivation) be brought back easily so as to pay startling rates of interest upon time and money expended upon them. Left uncared for, these remnants of Vermont farm orchards are standing menaces to fruit growing in the state.

Two points are of great importance in pruning: first, making the cuts close so that the wounds will heal over rapidly and, second, burning up the severed wood and brush before the insects which are on it and in it have a chance to escape. Wounds should be disinfected with a 1-1000 solution of corrosive sublimate and the larger cuts should be painted over with creosote paint or good white lead and oil.

Destroying Insect Eggs and Winter Quarters

This is the second general measure for the control of tree insects. Many of the most important species spend the dormant period of the tree in the egg stage, and their careers may be nipped in the bud very easily by inspecting the trunks, branches and twigs of the trees during fall, winter and spring for the presence of egg masses and destroying

all which are found. Some, like those of the tent caterpillar, may readily be picked off so as to be later burned; others, like those of the gypsy moth, are best killed by soaking with creosote. Cocoons of many species of insects may be found attached to the twigs or in the



Fig. 1.—Typical Derelict Apple-tree. Note brown-tail moth nest in upper right-hand corner. Original.

bark crevices, and in still other cases winter nests containing larvae may be clipped or picked off. The webs of the brown-tail moth and the cases of the leaf crumpler are instances of this. A light pole pruner is the proper instrument for this work.

Spraying. The third general form of artificial insect control is spraying, of which there are two main types based upon the practical division of insects as above described. For the chewing kind, stomach poison—generally an arsenical—is sprayed upon their food,



Fig. 2.—A Convenient Spraying Outfit for Orchards and Low Shade Trees.
Courtesy Vermont Agricultural Extension Service.

while for the sucking group a contact insecticide — something that destroys by coming in contact with their bodies — is sprayed upon them.

(*Note:* Dusting is a rather recently developed substitute for spraying, and under certain conditions may be advantageously used. Practically the same insecticidal materials are used as for spraying except that they are in dry form. A carrier, usually hydrated lime, takes the place of water. Prepared dusts, ready for use, are on the market. No specific directions for dusting are given herein, but in many cases it may take the place of the recommended spraying.)

Of the poisons, arsenate of lead and arsenate of lime (calcium arsenate) are the most satisfactory for tree use; of the contact insecticide, lime-sulphur, miscible or emulsified oils and nicotine sulphate

are most in use now. Lime-sulphur and the miscible oils are used chiefly for dormant spraying against scale insects; that is, they are applied to the bark when the trees are dormant or just as they are starting into life in the spring. Nicotine sulphate is the best remedy for plant lice and similar soft bodied insects.

Poison Insecticides. Arsenate of lead and calcium arsenate can be procured at most hardware stores. They are either in dry or paste form, the former being of about twice the strength of the latter.

The dry or powdered form should be stirred into a small amount of water before being added to the main dilution of water.

Contact Insecticides. Lime-sulphur can be had in concentrated solution or in dry form. The former is generally considered preferable.

There are several brands of the oils on the market of which Scalecide and Sunoco are possibly the best known in this section. "Black-Leaf 40" is a common brand of nicotine sulphate and is a highly concentrated form. Whale oil soap is a plant louse remedy of long standing, while kerosene emulsion is a good emergency spray material for contact use. It is made as follows: Slice up one pound of laundry soap into a gallon of boiling water. When it is completely dissolved remove the solution from the fire and immediately add two gallons of kerosene oil. Mix violently. This may be done to good advantage by pumping the solution back onto itself with a force pump. Rapidly pouring the material from one pail to another will answer the purpose. This is a stock solution. For foliage spraying dilute with water at rate of 1 to 6; for dormant spraying dilute at rate of 1 to 2.

Lime-sulphur at Summer strength. Lime-sulphur diluted at the rate of 1 to 35 is used as a foliage spray to prevent fungus diseases and may be combined with arsenicals and nicotine thus making a three-in-one spray. This combination is used principally on apple trees.

Rates of Dilution. In using specially prepared spray materials it is always best to follow carefully the directions on the package. On general principles, however, two or three pounds of arsenate of lead in the dry form (twice as much paste) is the proper amount for fifty gallons of spray. Commercial lime-sulphur should be diluted at the rate of one to eight, when used for dormant spray, and a half pint of forty percent. nicotine sulphate is sufficient for fifty gallons.

A combination spray which is used in summer on apple trees and which might be advantageously applied to shade and ornamental trees in many cases is made up thus:

Arsenate of lead (dry).....	2 to 3 pounds
Lime-Sulphur.....	1 $\frac{1}{4}$ Gallons
Nicotine-sulphate.....	$\frac{1}{2}$ Pint
Water.....	48 Gallons

In cases where it is not necessary to spray against fungus diseases, the lime-sulphur may be omitted.

A spreading or sticking agent is used by many in foliage sprays. A solution of soap added to the spray will answer this purpose but



Fig. 3.—Woodland Spraying.—Courtesy Mass. Department of Conservation.

should not be used where nicotine sulphate is combined with other materials. Casein is said to give very satisfactory results as a spreader, and there is at least one proprietary brand of this material on the market. Fish oil at the rate of 1 pint to fifty gallons of arsenate of lead gave excellent results in experiments in gypsy moth spraying by the U. S. Bureau of Entomology.

There is a great variety of spraying outfits from which the tree owner may choose according to his needs. The compressed air knapsack sprayer may answer the purpose in protecting a few small trees; a barrel sprayer with a hand pump is the next gradation and does well

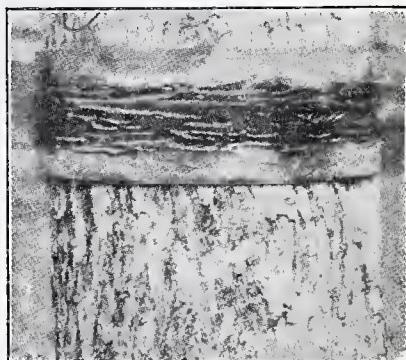


Fig. 4.—Sticky Band Applied to Tree Trunk.—Courtesy U. S. Bureau of Entomology.

for low shade trees and small orchards; the small power sprayer is an excellent piece of orchard equipment and can be used upon tall shade trees if climbing is done by the hoseman; for the best results, however, upon street trees a high power sprayer similar to those used by the U. S. Bureau of Entomology in gypsy moth control is necessary.

Spraying equipment is thoroughly discussed in Circular No. 30 Vt. Agricultural Extension Service by Prof. M. B. Cummings.

Tree Banding. A somewhat specialized measure of insect control is tree banding. This is of much importance in combatting canker worms and other species of similar habits where it is necessary for the females to crawl up the tree trunks in order to deposit their eggs; also it is of value in situations where larvae are likely to move from uncared for trees to those which are being protected, or where the insects eggs may hatch in stone walls or rubbish at the base of the tree.

Bands may be made from tree tanglefoot — a material similar to that on sticky fly paper and prepared by the same firm which manufactures the paper — or they may be made up from several different ingredients. Printers' ink reduced somewhat with heavy oil has been much used for this purpose. Five pounds of rosin melted up with three pints of castor oil makes a material which has been well recommended. Tree tanglefoot may be placed directly on the bark without injury to the tree. If home made materials are used, however, they should be applied upon a band of heavy paper which has been wrapped and fastened about the tree trunk. If the bark is very coarse, cotton batting should underlie the paper band in order to fill up the grooves and chinks.

NATURAL INSECT CONTROL

Nature, with its intricate system of checks and balances, has provided obstacles to the unlimited spread and increase of insects. If this were not so the world would have been totally overrun by this class of animal life aeons ago. Insect parasites, birds, disease, certain reptiles and mammals and inclement weather conditions all take their toll from almost any given species in its native element. It is through lack of these obstacles that transplanted species thrive so greatly.

There are various types of insect parasites. Some are so tiny that they spend all their growing period in the eggs of another; some develop in the larvae of their hosts; some are of the predaceous type — not parasitic in the strictest sense — which literally run down, tear to pieces and devour their prey. The U.S. Bureau of Entomology has made notable progress in seeking out the natural enemies of the gypsy and brown-tail moths in their native countries and distributing them here in the infested areas. The value of birds in destroying insects has become well recognized in recent years. Disease occurs where great numbers of insects, such as caterpillars crowd together, and it is an important element in overcoming unusual outbreaks.

Little can be done by the individual to assist Nature in this work except to protect the birds and give them every advantage possible.

Unfortunately there is a margin over all these hostile influences upon the insects' side of the balance, and it is against this surplus that the artificial measures of control, such as are recommended herein, are necessary.



Fig. 5.—An Illustration of Parasitism.—A—Parasitized Red-humped Apple-tree Caterpillars upon Leaf. B—Full grown Red-humped Apple-tree Caterpillar. C—Adult Parasite. Original.

TERMINOLOGY

It has been the purpose of the writer to keep this publication as free from technicalities as possible. What may appear like an exception to this is the including of the scientific names of the various species of insects at the head of each section. These, however, are of considerable importance to any who are referring to other publications for further information concerning the species mentioned, and also for any future compilation of insect records of Vermont. Common names

of insect species are very changeable, both in respect to time and locality. The forest tent caterpillar here is the maple worm there and the army worm somewhere else; the locust borer of to-day may be the robin beetle of tomorrow, but in all recent and, we expect, future literature concerning them, here and everywhere else, they are and will be *Malacosoma disstria* and *Cyllene robiniae*. The first word in this scientific naming designates the genus, the small group to which a number of similar kinds or species may belong, and the second word indicates the one particular kind or species of that group which is under consideration. Unfortunately it has taken time and there has been considerable confusion in arriving at a system of universally recognized scientific names. While they are now well established for practically all our common kinds occasional conflicts may be found. The personal name, usually abbreviated, which generally follows the two scientific names, indicates the entomologist who classified species as such.

TIMING CONTROL MEASURES

Since all too few people maintain the eternal vigilance which is the price of the security of their trees, it often happens that rapid increases of certain species of insects are not observed until serious outbreaks are in progress. Usually, in fact, knowledge of the situation comes too late for the inauguration of successful control measures against that season's brood of devastators.

In such cases all effort should be directed toward the prevention of a similar outbreak for the succeeding season. Full information should be obtained concerning the species in question and it should be attacked at its weakest points. In the case of leaf destroying insects careful watch ought to be kept for the first appearance of the larvae in the spring. This means very careful investigation.

It is not usually practicable to give specific directions as to time for spraying in a country of such irregular climatic conditions as ours. On certain years, for instance, the middle of May, which is sometimes suggested as the time for spraying, would be too late for the first foliage spray. On the other hand, there have been at least two seasons in the last decade when the middle of May preceded the appearance of any considerable foliage by two weeks.

It is, therefore, necessary to watch the progress of the season very carefully and to time control applications accordingly. Promptness in the work is as essential as the spraying ingredients.

LEAF EATING INSECTS

The Gypsy Moth

(*Porthezia dispar* Linn)

General. This insect, a native of Europe, was accidentally liberated at Medford, Mass., about 1869. It has spread out over practically all of New England and a small part of New York State. An infestation exists also in New Jersey. The whole of Vermont is

considered within the infested area. There is probably no other species of insect against which so much public control work has been done. While it has not yet (1925) become plentiful in most parts of Vermont, it is of great importance that all tree owners should familiarize themselves with the appearance of the insect in its various stages and thereby be ready to nip in the bud any tendency upon the part of the moth to attain the pest stage of its earlier days in southern New England.

Life History. In midsummer the eggs of the gypsy moth are deposited in masses or clusters of about 500 on the tree trunks and larger branches or sometimes on rocks, boards etc. about the trees. They are plastered over with a yellowish fuzz. As to size and shape a typical cluster may be conceived to have been cast in the bowl of a small teaspoon.

In May or early June the caterpillars hatch and crawl to the foliage upon which they feed during the five or six weeks of their growth. When full grown they are of a slatish hue with a prominent double row of spots down their backs. Five pair nearest the head are blue; the six pair following are red, and there are two smaller red tubercles between the rows near the hind end of the body. In the earlier molting stages the caterpillars are blacker in general appearance and the spots are less in evidence. The females attain a length of about three inches, the males being somewhat smaller.

When full grown the caterpillars crawl into bark crevices or any other convenient recesses, as under projecting woodwork, stone etc., and transform into the pupa stage. The pupae which are brown and from one third to three fourths of an inch long, are not enclosed in cocoons. Often numbers of them are found massed together.

They emerge as full fledged moths after about ten days. Roughly described the male adult is of a general brown color with darker brown markings. It has a wing expanse on the average of about an inch. The female is considerably larger and is white with black markings. Both sexes vary greatly in size, however. The male flies, chiefly in the bright sunlight; but the female, though she has wings, cannot fly. These adults live but about a week, being found in greatest numbers in late July and early August.

Damage and Foodplants. The insect is destructive only in the caterpillar stage, but in that period it is an extremely ravenous defoliator of many kinds of trees. Apple, oak, birch, beech, basswood, willow and tamarack are among their prime favorites, but a great many other trees including maple, elm and pine may suffer from their attacks in heavy infestations.

Wherever the gypsy moth becomes plentiful many trees are killed outright by repeated strippings, but dead trees by no means indicate the whole loss from the work of such leaf eating insects. The reduction of the growth and the weakening of the trees so as to render them susceptible to attacks of fungi and other enemies constitute the greater damage.

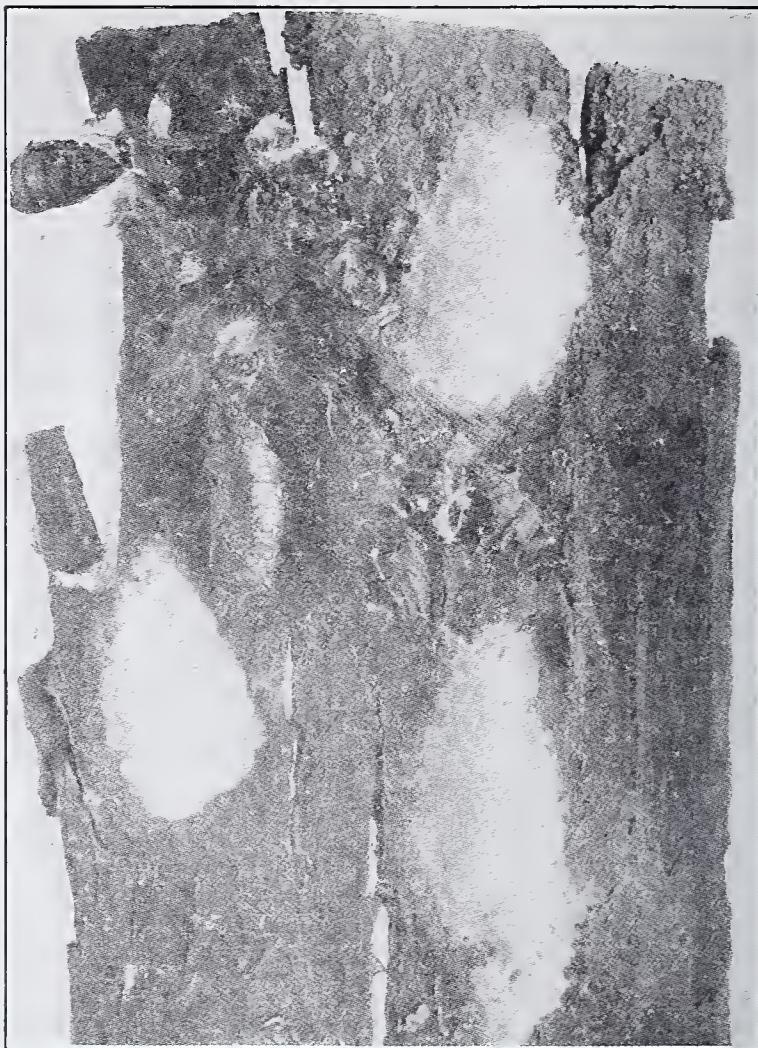


Fig. 6.—Egg Masses of the Gypsy Moth. Courtesy Conn. Agricultural Experiment Station

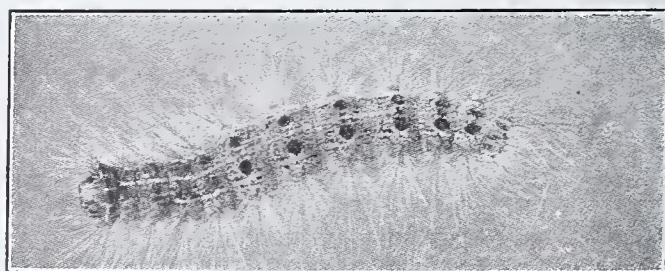


Fig. 7.—Full Grown Gypsy Moth Lava. Courtesy Conn. Agricultural Experiment Station.

Control. Sometime during the dormant period of the trees all the trunks and main branches should carefully be looked over for the presence of egg masses, and if any are found they should be treated with creosote. This material will be furnished by the Department for the purpose, upon request from anyone owning or in charge of trees in the state. Spraying the foliage with an arsenical is another very important control measure. The calyx spray, as applied on apple trees for the codlin moth, is effective against the gypsy moth.

Since egg masses may be laid at the base of the trees, especially in stone walls, banding is sometimes a very feasible method of protection, though it can seldom be depended upon alone. See Fig. 4.

During the heat of the day the caterpillars seek shade, and if burlap bands are tied about the trunks of infested trees so folded that caterpillars may crawl under them, great numbers may be trapped. The bands should be inspected and the caterpillars crushed at least once a day. Like banding, this is primarily a supplementary measure for use in cases of heavy infestation.



Fig. 8.—Male Adult Gypsy Moth.
Courtesy U. S. Bureau of Entomology.

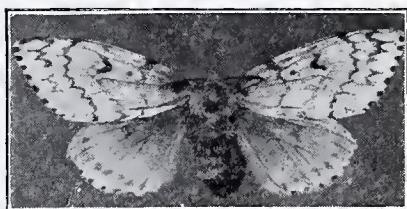


Fig. 9.—Female Adult Gypsy Moth.
Courtesy U. S. Bureau of Entomology.

Care should be taken to see that neither caterpillars of this species nor egg masses are upon materials conveyed or shipped from points where the insect is plentiful to lightly or non-infested sections. Inspection is required for the shipment of forest and quarry products from within the area quarantined by the U. S. Federal Horticultural Board to points outside.

Public Control Work. A large amount of control work has been directed against the gypsy moth in Vermont by the U. S. Bureau of Entomology as well as the State Department of Agriculture.

Throughout the eastern portion of the State only investigational and advisory measures are now being carried out and it devolves upon individual tree owners to combat the insect so far as direct measures are concerned.

The Forest Tent Caterpillar (*Malacosoma disstria* Hbn.)

General. Perhaps no native insect of the trees has made a deeper impression upon the forests as well as upon the minds of the people in Vermont than the forest tent caterpillar, sometimes known

as the maple worm, the forest caterpillar and, most improperly, the army worm; for it was this species which devastated the sugar orchards and street and shade trees during several seasons around 1900 and again, to a lesser degree, about 1914. It is always with us to a certain extent, and even in those years when it is not spectacular in its abundance it is usually taking its full share of the toll of insect damage to the foliage of the trees.

Seasonal History. During the winter it is in the egg stage, the little ring-like masses encircling the twigs of maple and other food plant trees. These masses are somewhat smaller than those of the common tent caterpillar and are more drum-like in form. The eggs hatch as soon as the foliage puts out and the tiny blackish caterpillars remain together in groups for a time. Later they scatter about the foliage, and when fully grown spin cocoons in bark crevices, bunches of leaves, etc. Unlike their cousins of the apple tree, they spin no tents or conspicuous webs. Instead they cluster together in little mats upon the tree trunks when not feeding, and it is one of their characteristics that they snap the foreparts of their bodies rapidly about when disturbed. Pupation within the cocoons takes about two weeks and the adult moths which emerge from them may be found about the lights during midsummer.

These moths are yellowish brown, with darker colored bars across the fore wings. The female has a wing expanse of about an inch and the male is slightly smaller. The caterpillars, at first nearly black, take on a bluish color marked with fine reddish yellow lines running lengthwise of their bodies; along the middle of the back is a chain of diamond shaped white spots. Full grown caterpillars average about two inches in length. The cocoon of whitesilk, stiffened with a yellow substance resembling sulphur, varies little from the familiar cocoon of the apple tree tent caterpillar.

Food Plants. Maple, oak and poplar probably are the prime favorites of this species but many other varieties are seriously attacked including the apple tree.

Control. Collection and burning of the egg masses is only feasible in the case of small and isolated trees. A liberal spraying with an arsenical when the caterpillars are small is the principal control measure. See: Bulletin No. 76, Vt. Agricultural Experiment Station, the Forest Caterpillar.

Eastern Tent Caterpillar

(*Malacosoma americana* Fab.)

General. Of more importance to apple trees but of less importance than forest species to trees in general is the eastern, common, or apple-tree tent caterpillar. This insect, through the conspicuousness of its work, affords a first class illustration of the variations in standing to which a native insect is subject. Through a series of years very few indeed of the white tents or of the caterpillars them-

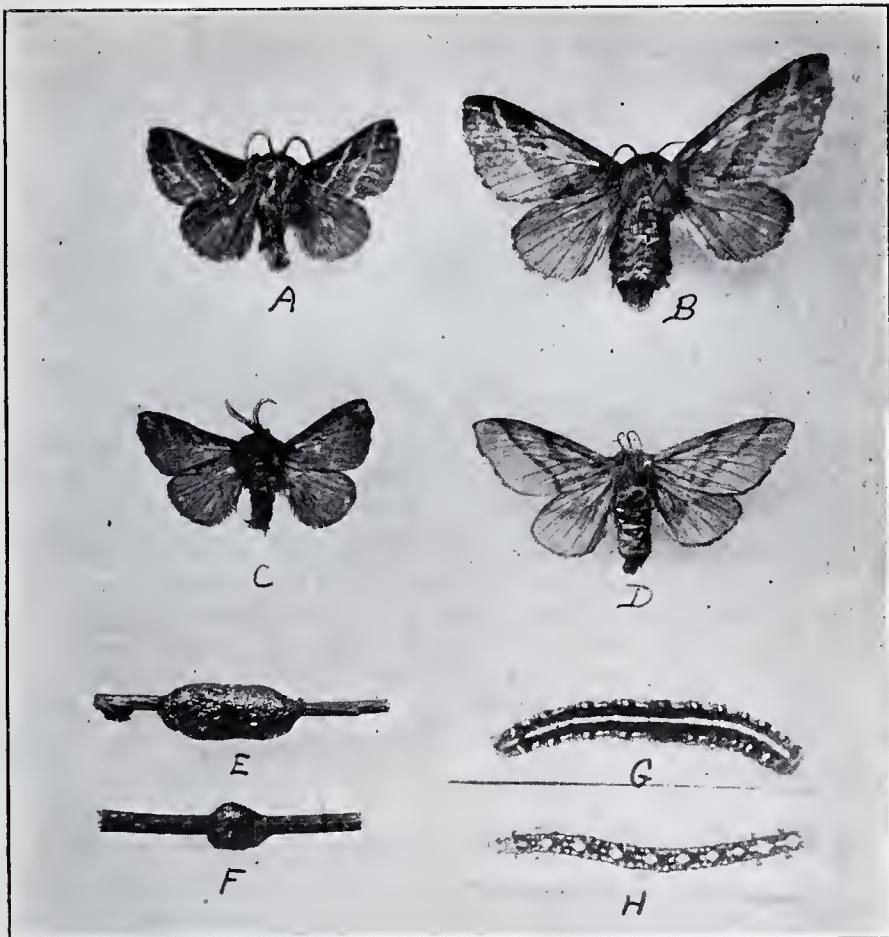


Fig. 10.—The Tent Caterpillars.

A and B—Male and Female Adults of Apple-tree Tent Caterpillar.
 C and D—Male and Female Adults Forest Tent Caterpillar.
 E—Egg Mass of Apple-tree Tent Caterpillar. F—Egg Mass of Forest Tent Caterpillar.
 G—Larva of Apple-tree Tent Caterpillar.
 H—Larva of Forest Tent Caterpillar. Original.

selves will be seen during the feeding period in the spring; then more and more appear through several succeeding seasons, and finally they attain to such numbers that almost every uncared for apple tree and wild cherry tree will literally be enshrouded with their white webs and will be stripped completely of foliage. After a summer or two of maximum abundance the natural enemies tip the balance again, and the caterpillars are off on another period of decline.

Seasonal History. Egg masses of the tent caterpillar are deposited upon the twigs, chiefly of apple and wild cherry early in the summer. They are dark colored, glue-like objects encircling, or "saddled upon" the twigs. Most of them are about half an inch long.

The tiny caterpillars are formed within the eggs early in the winter, but do not break out until the leaf buds begin to open. They then begin feeding upon the expanding foliage and continue to do so for about four weeks. It is their habit, when not feeding, to return to a nearby fork in the branches and as they do so to spin white silk threads. These places of rendezvous soon take on the tent-like appearance from which the insect derives its name. The full grown larva is about two inches long, in general appearance yellow and black with a white line down its back. The cocoons which the caterpillars spin in bark crevices, beneath fence rails and clap-board edges or in most any other convenient recess, are familiar objects. The moths appear late in June. They vary in color from light tan to dark brown and the four wings are marked by two parallel transverse white lines.

Food Plant. Apple and wild cherry stand out as altogether the favorite food plants, though many other varieties of trees have been recorded in the list which it attacks.

Control. Picking off and burning the egg masses is a practicable and effective measure of control, but the so-called pink spray (arsenate of lead, lime-sulphur and nicotine solution) affords a very effective remedy for the attacks of this species in combination with other troubles. It is not safe to depend upon the calyx spray for the control of this caterpillar because most of the damage occurs before the blossoming period is over. Gathering and crushing the nests of caterpillars is of some value.

Canker Worms.

General. The fall canker worm (*Alsophila pometaria* Harr.) and the spring canker worm (*Paleacrita vernata* Peck) are to us the most important members of that large moth group spoken of as the geometrids, inch-worms, span-worms or loopers. They are among the oldest recorded insect pests in the country, though their serious outbreaks are so local in character and come at such irregular intervals that each fresh appearance leads many people to believe that an entirely new pest has become established. The report of the U. S. Entomological Commission for 1882 contains a very exhaustive account concerning the canker worms by Prof. C. V. Riley. This shows that eastern New England suffered a scourge of the canker worms from 1790 to 1795 and again around 1815. Outbreaks at irregular periods from that time to the date of the report are recorded, and we personally recall a very serious outbreak in Essex County, Mass. in the early nineties. In 1913-14-15 the insects did much damage to the trees at various points in Vermont; then they suffered a decline which will probably be replaced by another period of abundance within the next few seasons.



Fig. 11.—Spraying vs. Non-spraying Against Leaf Eating Insects.
Courtesy Mass. Department of Conservation and Fitzhenry—Guptil Co.



Fig. 12.—Young Tent Caterpillars Beginning to Form a Tent. Note attack upon buds before leaves have come out. Original.



Fig. 13.—Forest Tent Caterpillar at Work. Original.

Seasonal History. The terms "spring" and "fall" as applied to these species refer not to the appearance of the larvae or "worms" but to the seasonal appearance of the adult moths. In the case of the fall species the brownish gray, satin-like males and the gray wingless females emerge from the ground in the fall—mainly in October, here,—and eggs are deposited in little groups on the bark. The adults of the spring species, which are very similar to those of the fall canker-worms, emerge in the spring. We have observed them as early as March 30th, but the period usually begins somewhat later. The eggs of both species hatch at about the same time —coincident with the flowering of the red currant, according to observations of Harris, nearly a century ago — and the little caterpillars begin their work upon the newly expanding leaves.

These larvae, at first nearly black in color, become green or yellowish green in the case of the fall species and various shades of ash or brown to a dark olive green in the case of the spring species. There are two pale narrow longitudinal lines along the back of the latter species and the intervening space is usually much darker than the rest of the body.

Both worms are about an inch long when full grown, very slender, and are naked. Like all the geometrid larvae or inch-worms, they lack the full number of fleshy false legs, or pro-legs, common to most caterpillars, and instead of the regular crawling movement of most insects they progress by bending up their bodies and then springing themselves forward. Many may be found suspended from the branches of infested trees on silken threads.

The feeding period lasts about four weeks at the end of which the worms crawl down into the soil and pupate. Those of the fall species form little cocoons about a third of an inch long, but those of the spring species simply make little pupal cells in the earth.

Food Plants. Our observations in Vermont point to the elm and apple as prime food plants for the spring species and elm, maple and apple for the fall species though it may be found to some extent on many other varieties.

Damage. Unlike conditions reported in some other states, the spring cankerworm seems to have been the more serious of the two in Vermont.

In heavy infestations complete stripping of the foliage occurs, and the damage is very severe.

Control. Since the females of both species are wingless and pupation takes place in the ground it is necessary for them to crawl up the tree trunks in order to deposit their eggs. Therefore sticky bands applied previous to the time of their emergence, i. e. late in September and late in March, afford considerable protection. Either the moths are caught in or deposit their eggs beneath the bands. In the latter case the caterpillars naturally starve to death soon after hatching.

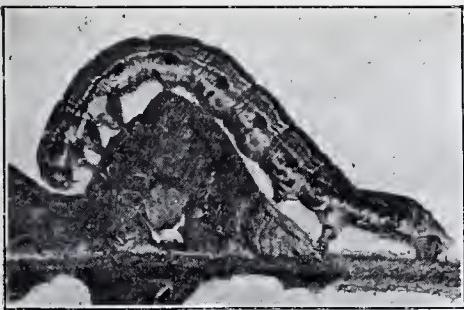


Fig. 14.—Fall Canker Worm (enlarged).
Courtesy U. S. Bureau of Entomology.



Fig. 15.—Spring Canker Worms (enlarged).
Courtesy U. S. Bureau of Entomology.



**Fig. 17.—Adult Female Canker Worm
Depositing Eggs (enlarged).**
Courtesy U. S. Bureau of Entomology.



**Fig. 18.—Work of Fall Canker Worms in Apple Orchard.
Original.**



**Fig. 16.—Adult Male
Canker Worm.**
Courtesy U. S. Bureau of
Entomology.

A thorough spraying with an arsenical immediately after the leaves come out is also a good control measure. The "pink spray" is effective for this purpose. In severe infestations both banding and spraying are recommended.

The Lime-tree Winter Moth

(*Erannis tiliaria* Harr)

Another geometrid moth which is very similar in habits to the fall canker worms and which should rank next in this group to them so far as destructive work in Vermont goes is the lime-tree winter moth or looper. Lime-tree refers to the basswood, or American lime, and winter to the time of year at which the adults emerge, though the name was evidently chosen in some less rigorous climate than ours in Vermont where the moths appear in October and November.

A serious outbreak of this species occurred in Vermont in 1924-5.

It is slightly larger than the cankerworms in all stages, the male adults having a wing expanse of about two inches, and the larvae attaining a length of about an inch and a quarter. They are also somewhat more elaborate in color. The males are of a yellowish orange hue while the females, wingless like their relatives, the canker worms, are black and white. The larvae are yellow with ten fine black lines running lengthwise on their backs, and the heads are red. They may be found feeding somewhat later than the cankerworms.

Food Plants. This species attacks a large variety of hardwood foliage of which bass is probably the prime favorite. Elm, apple, maple, and oak, may be seriously attacked.

Control. Banding the trees in the fall and spraying with an arsenical in the spring are the prescribed treatments. Both the pink and the calyx sprays are effective against this species.

The Elm Leaf Beetle

(*Galerucella xanthomelaena* Schrank)

General. The elm-leaf beetle, a native of the Old World, was first found in the United States at Baltimore in 1838. It has been present in Vermont for at least fifteen years and has been found in damaging numbers as far north as Windsor on the eastern, and Middlebury on the western sides of the state.

Infestation. Students of the situation have held that the species has reached about the northern limit of its range and that little further spread need be feared. Observations in Vermont point to the correctness of this theory in general; no spread of the beetle has been noted during the past six years above Windsor in the Connecticut River Valley, nor away from the larger valleys into the towns of higher

altitude, even in the southern part of the state. It apparently has advanced northward along the Otter Creek Valley, and there appears to be no reason to suppose that it may not proceed as far, at least, as Burlington, in the Champlain Valley.

The territory infested, however, includes some of the largest towns in the state, and the presence of the beetle there demands careful attention.

Life History and Habits.

During the winter the adult beetles are hidden away under loose bark scales, within cracks in poles, posts, etc. and quite frequently in attics and unused rooms



Fig. 19.—Elm Leaf Beetle Larvae at Work.
From Bulletin 333, Cornell University Agric. Exp. Sta.
Photo by Slingerland

or buildings into which they work their way around the windows. They are of a yellowish color with a dark stripe down each wing cover, the line of meeting of these covers giving the appearance of a third, narrower, stripe down the middle of the back. By spring the yellow usually has become a dark brown. They are about a quarter of an

inch long. As soon as it becomes warm enough for the leaf buds to begin to open, these beetles appear from their winter quarters and start feeding upon the expanding leaves.

The females shortly commence depositing little double rowed masses of orange colored eggs upon the under sides of the leaves, from which the grubs or larvae appear in about six days.

This is the crawling, growing, and heaviest eating stage of the insect. At first these grubs are very dark yellow, small, having emerged from eggs no larger than pin heads, and are tapering or "alligator" shaped. They grow rapidly, becoming lighter yellow, with dark stripes down each side of the back, and in from two to three weeks they attain full size and stop feeding which — this is important —has been done entirely from the under surface of the leaves, so that the veinlets and upper tissues remain. The full grown larvae then crawl down the tree trunks and pupate, either on the ground close to the trees or in the crevices in the bark, low down on the trunks.

Fig. 20.—Adult Elm Leaf Beetles and Their Work. From Bulletin 333 Cornell University Agri. Exp. Sta. By Glenn W. Herrick.



The pupae, are less than a quarter of an inch long, not quite as broad, pointed at one end, and of an orange color. After spending from 7 to 12 days in this stage, the pupae change to adult beetles and the life cycle is completed.

In warmer climates there may be a second brood of the beetles during the season, but this seldom if ever happens in Vermont.

Food Plant and Damage. Elm is the only known food plant of this insect. It is the skeletonizing of the leaves by the larvae which so seriously damages the trees. Sometimes every leaf is affected; many curl up and drop off, while others which remain are of no value in supporting the vigor of the trees. Two or three severe attacks in consecutive seasons generally suffice to kill or very seriously weaken the infested tree.

The elm leaf beetle is particularly a city and village pest, presumably because of the close grouping of elms along the streets and the ideal winter quarters afforded to the beetles by the houses close to the trees.

Control. Control lies chiefly in spraying. This should be started with a heavy dosage of arsenate of lead or of lime as soon as the leaves are well out so as to destroy as many as possible of the over-wintering adults before egg deposition. Later, when the grubs have begun work, spraying should be repeated, care being taken to direct it against the under sides of the leaves so far as possible.

On warm days in spring many of the adults may be killed around attic windows.

Late in the summer many pupae, larvae ready to pupate, and newly developed adults may be killed by applying hot water or a contact insecticide on and about the trunks of the trees, or by scraping up the leaves and debris and burning them.

The Saddled Prominent

(*Heterocampa guttivitta* Walk.)

General. At irregular intervals and at scattered points severe ravages of a moth known as the Saddled Prominent occur. It is a native insect, but is so well subjected to the control of natural enemies that it is inconspicuous much of the time. When it does appear in its periods of abundance, however, its work is severe indeed. During the summers of 1918 and 1919 many sugar bushes and other hardwood stands were completely defoliated in southern Vermont, and it was reported as extremely plentiful in Maine, and New Hampshire some ten years previously.

Damage. A heavy infestation by this species for two or three seasons apparently not only results in killing many trees but in greatly lessening the sap runs from the remaining attacked trees.

Description and Habits. The adult is a dull grayish moth with a wing expanse of about an inch and a half. It emerges from the pupa, which has spent the winter in the leaf mold, late in May. Eggs are deposited and the tiny caterpillars hatch in midsummer. At first they are adorned with queer antler-like appendages which disappear with subsequent moltings. The full grown caterpillar is about an inch and a quarter long, slightly tapering at each end, and practically hairless. The general color is green and in most cases it has a claret red saddle shaped mark on the back. There is some variation in the shape of this mark, however, and the body color in some cases is pinkish.

Food Plants. Besides maple these insects severely attack beech, hop-hornbeam and to a lesser extent various other kinds of northern hardwood foliage. It has been reported as destructive to apple trees in Maine. For some reason the attacks upon maple and other forest growth in this state appear to be most severe upon the hill tops.

Control. Spraying with arsenate of lead or calcium arsenate in mid-summer offers the only feasible means of control, and this, of course, applies only to small groves or especially prized trees.

The fiery ground beetle, a native *Calasoma*, is a very efficient natural enemy of this species.

The Green Striped Maple Worm or Rosy Dryocampa

(*Anisota rubicunda* Fabr.)

General. Among the hoards of moths clustering about the lights on warm midsummer nights may usually be found some very pretty creamy yellow, rather heavily built; specimens with rose colored

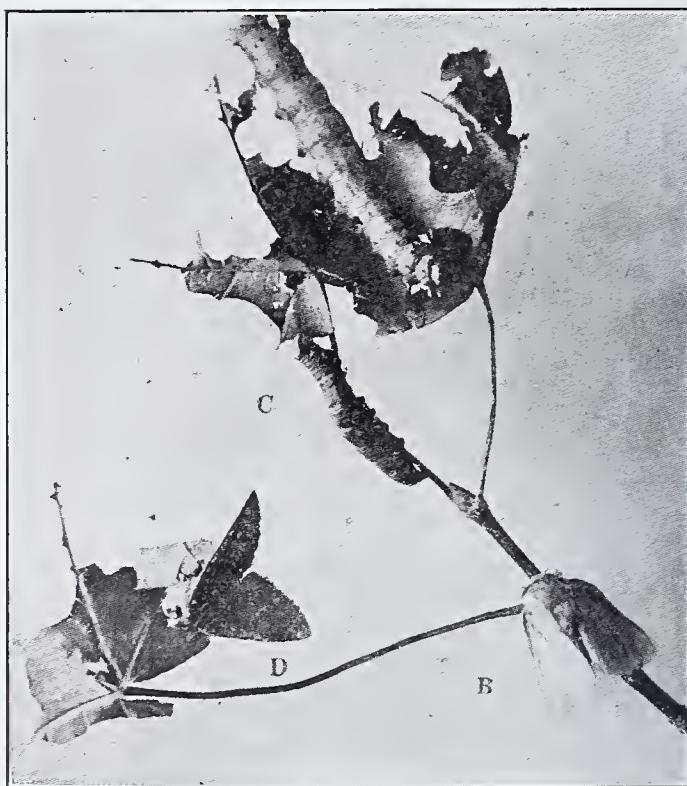


Fig. 21.—Green-striped Maple Worms and Saddled Prominent.
A—Larva Green-striped Maple Worm. B—Adult Green-striped Maple Worm. C—Larva, Saddled Prominent. D—Adult Saddled Prominent. Original.

forewings marked with a transverse creamy bar. They have a wing expanse of about an inch and a half. These are the rosy dryocampa moths, the adults of the green striped maple worms which sometimes seriously attack maple foliage.

Habits. The worms or caterpillars generally hatch early in July, but their work does not become evident until considerably later when they are approaching maturity and are feeding very rapidly. At first they keep close together in rows, but scatter over the foliage as they grow older. Smaller trees, particularly of the soft varieties, frequently are completely defoliated by their work, though the species is more evenly distributed as a rule than is the case with the saddled prominent.

The full grown caterpillar is about two and a quarter inches long. It is light green, marked with dark green longitudinal stripes.

The head is reddish and back of it are two black horn-like appendages. At the end of the feeding period the larva works its way into the leaf mold, transforms into a very hardshelled pupa and remains in that state until the next summer when the adults emerge and the eggs for the next brood are laid. In Vermont there appears to be but one brood annually.

Control. Where there are but a few trees together, the raking up of the leaves and top leaf mold and burning it would destroy many of the pupae.

A liberal spraying with arsenate of lead wherever feasible is the most practical means of control.

The Rosy Striped Oak Worm and the Yellow Striped Oak Caterpillars.

(*Anisota virginiensis* Dru.) and (*Anisota senatoria* Abb. & S.)

Closely related to the green striped maple worm are these two species both of which attack principally oak foliage. The rosy striped oak worm is about two inches long when full grown, of a general brownish color with reddish stripes as the name implies. The skin of this and the related species, is very coarse and is practically hairless. It has a general distribution in the state.

The yellow striped oak caterpillar is similar in shape to the other members of the genus and is aptly described by its name. It appears to be particularly plentiful on the white oaks in the upper Champlain Valley, especially about St. Albans Bay.

Arsenical sprays applied when the work first commences will afford control.

Green Maple Worms

(*Xylina spp.*)

Not to be confused with the green striped maple worms are the green maple worms which are also known as the green fruit worms when considered as orchard pests. Holland has applied the name Ashen Pinion to the adult moths. There are three species of these so-called worms which are so like in appearance that it requires close observation to separate them. The larvae are light green sprinkled

with very fine white dots and marked with faint white lines, one running lengthwise of the back being most distinct. The heads are yellowish. When full grown the larvae are about an inch and a half long. Occasionally specimens are found which are of a pinkish hue, while other variants are yellow.



Fig. 22.—A Green Maple Worm to which is attached the cocoon of a parasite. After Slingerland, Bulletin 123, Cornell University Agric. Exp. Sta.

The adults are grayish inconspicuous moths of the noctuid or owlet group. They appear in the spring and deposit eggs upon the foliage. From these the caterpillars or worms soon hatch and spend the next four or five weeks devouring the leaves and, in some cases, the young fruit. In several heavy infestations in Vermont observed by the writer the species *Xylina lacticinervia* appears to have predominated, though *X. Antennata* has been recorded by Dr. E. P. Felt as having been particularly plentiful at times in New York state.

Food Plants. Soft maple is rated as the prime food plant of these insects, but black ash and willow were completely defoliated in the northern part of the Champlain Valley in 1924. In the Sand Bar Bridge section hardly a tree of the former species retained its leaves. Oak, poplar and hickory also were heavily attacked.

Control. Arsenical spraying as soon as the larvae begin work is the remedy.

The Birch-leaf Skeletonizer

(*Bucculatrix canadensisella* Chambers)

This is a native species which occasionally becomes extremely plentiful — so much so that the birches turn yellow prematurely in late August or early September throughout wide areas. Such was the case in Vermont in 1923 and 1924.

The adult is a tiny moth and the larvae are very slender, naked, green caterpillars, about a third of an inch long when full grown. They feed on the under sides of the leaves, eating out the tender tissues and leaving the upper surface thin and sere. In the course of their work they form curious little weblike cushions upon which molting takes place. When full grown the larva makes a ribbed cocoon, about a fifth of an inch long, attached to the under side of the leaf. There is but one generation each year.



Fig. 23.—Spiny Elm Caterpillars at Work. Original.



Fig. 24.—Work of Maple-leaf Cutter. Work of Birch-leaf Skeletonizer.
Note Cocoons and Cushions. Original.

Damage. The damage caused by the birch-leaf skeletonizer probably lies more in the defacement of shade and ornamental trees than in the physiological injury, because of the lateness in the season at which the feeding is done.

Food Plant. It attacks both white and yellow birches. In the case of shade and ornamental birches careful watch should be maintained for the appearance of the larvae around the middle of August, and arsenate of lead should then be applied.

The Brown-tail Moth

(*Euproctis chrysorrhoea* Linn)

General. About 1890 the brown-tail moth, previously unknown in the United States, was found in Somerville, Mass. It probably had been brought in on nursery stock from Holland. Despite suppressive work by the various states and the federal government, the insect spread rapidly and by 1914 had infested the eastern portion of Vermont. A combination of unfavorable climatic conditions and the effects of the control work, both artificial and through the distribution of parasites, then started it on a decline from which it has not since recovered. There has been no serious infestation in the state from 1917 to the date of publication, though occasional winter nests have been located during several different seasons within this period in the Connecticut River towns. There is always danger of such an insect working back, and its appearance should be known so that any recurrence of the pest may be immediately recognized and dealt with.

Description and Habits. The adults—small white moths with brown tails—appear in mid-summer. They are strong in flight, and travel many miles under certain conditions. Great numbers may sometimes be found swarming about street lights or at rest upon the poles and adjacent buildings in the morning. The females deposit their eggs on the under sides of the leaves and these hatch out late in August or early in September. The tiny caterpillars which hatch from these masses of eggs begin feeding upon the foliage nearest them and during the course of their fall feeding spin close webs about themselves in which they spend the winter. These webs or nests are tightly fastened to the twigs and somewhat resemble dried leaves of which, in fact, they are partly composed.

About the time the leaf buds open in spring these small larvae, which have remained dormant throughout the winter, emerge from the webs and resume feeding upon the foliage. After about a month they spin loose cocoons among the leaves and pupate within them. The adult moths begin to emerge from the pupae early in July.

The full grown brown-tail larva is about an inch long, brown and hairy. There is a double row of white dashes running lengthwise of the back and two red tubercles near the hind end.

Food Plants. Apple, pear, oak and cherry are prime favorites with this species, but maple, elm and various other deciduous trees may be seriously attacked.

The Damage it Does. Defoliation by these caterpillars is especially serious because it comes early in the season and is very thorough. Where gypsy caterpillars also are prevalent, the injury is still more severe because new foliage putting out after the stripping by the brown-tails may be taken off in turn by these later feeding larvae.

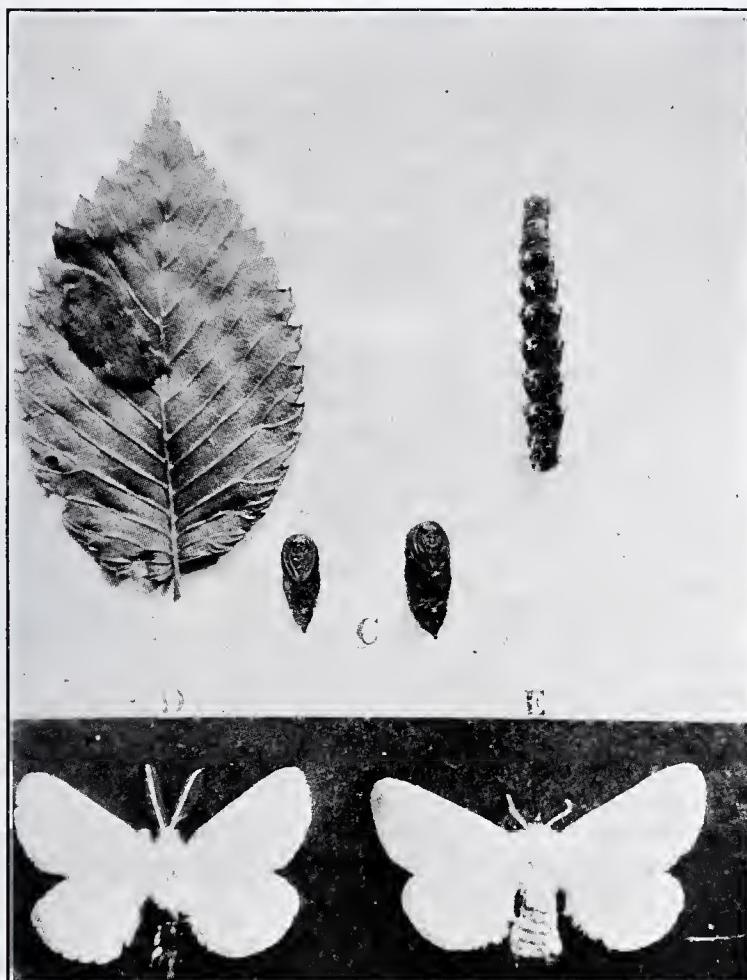


Fig. 25.—The Brown-tail Moth. A—Egg mass—B—Larvae—
C—Pupae. D—Male Adult E—Female Adult. Original.

Poison to the Touch.

The brown-tail is highly undesirable, too, owing to the fact that it is poisonous to the human skin. Great discomfort, sometimes with serious results, has been suffered among residents of the thickly infested regions.

Control. Cutting off and burning the winter nests, and spraying the foliage with an arsenical as soon as it is out sufficiently in the spring and again, in cases of heavy infestation, in the fall are effective control measures.

The Spiny Elm Caterpillar

(*Euvanessa antiopa* L.)

Description and Habit. The adult of this species is a large handsome butterfly, deep purple with a narrow yellow margin on its wings, from which coloring the name mourning cloak presumably is derived.

These adults appear in early spring after having spent the winter hidden away in crevices and holes in the trees, deposit their eggs in little masses somewhat similar to those of the tent caterpillars on the twigs, and larvae begin to hatch soon after the leaves are well out. The newly hatched larvae are at first of a reddish color, but soon become dark and in the later molting stages have a row of red spots on their backs. They are well armed with prickly spines which somewhat resemble large hairs. When ready to pupate they are about two and a half inches long.

After scattering about the foliage, they form large chrysalids from which new adults soon emerge. In Vermont it is seldom that there is more than a partial second generation in the season, though in warmer locations there are several full broods. Since this insect spends the greater part of its existence in the adult stage the butterflies may be found throughout all but the cold months.

Food Plants. Elm, willow and poplar constitute the food plants of this species.

Damage and Importance. The habit of the larvae of clustering close together and thereby completely stripping certain branches, and also its similarity to the gypsy moth caterpillar, on casual observation, sometimes gives their presence a more alarming aspect than their real importance warrants. Severe infestations, however, may cause considerable damage to trees.

Control. The spiny elm caterpillar is very susceptible to arsenical spraying such as is carried out for the gypsy moth, forest tent caterpillars and em leaf beetle.

The Tussock Moths

General. There are three species of tussock moths to be found generally scattered about the state: the rusty tussock moth (*Notolophus antiqua* L.), the white-marked tussock moth (*Hemerocampa leucostigma* S. & A.) and the well or definite-marked tussock moth (*Hemerocampa definita* Pack). They are all similar in habits and appearance and are closely related to the gypsy and brown-tail moth though it is seldom, if ever, in this state that they become seriously

abundant. Rather, they are among that great hoard of insects which are inconspicuous by themselves but which combine to take the yearly heavy toll from vegetation.

The rusty tussock moth appears generally to be most plentiful in this state, though the white-marked species is common and has attained to pest proportions in some parts of the country.

It is of especial importance that the novice in looking for gypsy moth egg masses should be familiar with the egg stage of these moths, since they may be found in the same general locations and in a superficial way resemble those of the more important species.



Fig. 27.—Egg Mass of the Rusty Tussock Moth. Original.



Fig. 26.—Brown-tail Moth Winter Nest. Original.

Description and Habits. The eggs of the rusty tussock moth are deposited in closely packed groups, placed side to side in one tier. Those of the white marked tussock moth are piled up in a mass covered with white frothy substance and those of the well marked tussock moth are covered with a yellow fuzz similar to that covering the gypsy moth eggs. In every case, however, the tussock moth eggs are deposited on the outside of the cocoon from which the parent female emerged, and while many of them are in bark crevices or attached flatly to the trunks, some are situated upon leaves attached by silk to the twigs.

The full grown rusty tussock caterpillar is about an inch and a half long. Pencils of black hair project like horns from each side of the head. There is also a projection of the same sort from the hind end of the body, and one standing out horizontally from each side, about a third of the way back from the head. Four tufts of whitish hair—these vary in color somewhat—stick straight up on the back, like miniature brushes, and the body is marked by a number of red tubercles on a black general color.

Pupation takes place in midsummer, and the adult males are of the reddish rusty color from which the name is derived. They are of about



Fig. 28.—Egg Mass of the White Marked Tussock Moth. Original.

an inch in wing expanse. The females are wingless as is the case with the other two species. Occasionally a season is long enough so that there is a partial, if not a whole, second brood in the summer, but more often the eggs deposited by the females which appear in July remain unhatched until spring.

The larvae of the white-marked tussock moths are of about the same shape as and a trifle larger than these of the foregoing. In color they are yellow, black and white, with red heads.

The well-marked tussock larvae are much like the white marked but are of a general paler coloring.

These caterpillars are general feeders upon hardwood foliage, maple, elm, oak and apple being favorites.

Control. Spraying as for the similar leaf eating insects and destroying the egg masses during fall, winter and spring will serve to control these insects.

The Elm Leaf Miner

(*Kaliosysphinga ulmi* Sund.)

Leaf miners are tiny larvae which work between the upper and lower surfaces of the leaves. One particularly destructive species is known as the elm-leaf miner. It is particularly attracted to the Camperdown elms commonly used for ornamental purposes about lawns, parks and private grounds. Native American elms sometimes are seriously devastated by them, however. In serious attacks the leaves all turn brown, and the grub-like larvae can plainly be seen within the tissues of the leaves by holding the infested foliage up to the light.

Damage. Damage consists, not only of the weakening of the trees but in the disfigurement of the foliage.

Control. The infested trees should be sprayed soon after the work of the miners becomes apparent with nicotine-sulphate. This material is sufficiently potent to penetrate through the epidermis of the leaves.

Maple Leaf Cutter

(*Incurvaria acerifoliella* Fitch)

General. Similar to the leaf miners is the maple leaf cutter which is common in Vermont and frequently causes considerable alarm by its attacks upon the foliage of sugar maples. It is, in the adult stage, one of the tineid moths. The eggs are deposited early in the summer upon the leaves and from these grub-like caterpillars soon hatch. These larvae begin by cutting out round patches from the leaves and then turning these cutout disks over upon the solid portion of the leaf surface with themselves in between. They tie the edges down with silken threads which they spin, and then cut out the portion of the leaf upon which they are resting, taking pains, however, to keep one edge fastened to the leaf as though it were hinged. When through

feeding the larva pupates within this case and spends the winter thus among the fallen leaves. See Fig. 23.

The lower branches of maples seem most severely attacked, and late in the summer they take on a burnt and ragged appearance wherever the leafcutters are prevalent.

Damage. Real damage probably is not great owing to the lateness of the season at which the insect feeds; it must nevertheless, draw to some extent upon the vigor of the trees, and presumably detracts to some extent from the sap run of the following season.

Control. Raking up and burning the leaves offers the best means of control.

The Arbor Vitae Leaf Miner

(*Argyresthia thuiella* Pack)

Another leaf miner which has attracted considerable attention in various parts of the state during recent seasons is the arbor vitae leaf miner. The effect of the work of this species is the browning of the tips of the twigs of the arbor vitae trees, and while the damage caused to the trees may not be great from a physiological standpoint, their appearance is greatly marred, especially in the case of hedges where this variety of tree is used.

Control measures have not been well worked out as yet, but Dr. W. E. Britton, State Entomologist of Connecticut, reports apparently beneficial results from the use of both arsenical and contact insecticides.

The Yellow Necked and the Red Humped Caterpillars

(*Datana ministra* Dru. and *Schizura concinna* S. & A.)

General. These two native species, usually insignificant in importance, sometimes become so abundant that they strip young orchards and various kinds of shade trees of their foliage. Their presence has often led to false alarms of gypsy moth discovery.

Their habits are, for practical purposes, identical. Adults deposit eggs in midsummer; the caterpillars soon hatch and begin feeding upon the foliage and, since all those which hatch from one egg mass stay close together, their work is characterized by the stripping of single branches scattered about the trees except where they are abundant enough to defoliate them all. As the egg laying period covers several weeks, groups of newly hatched caterpillars may be found on the same trees with fully grown ones. See Fig. 31.

Description. The common names well characterize these insects. The yellow necked caterpillars when approaching maturity are black, striped lengthwise with yellow and there is a band about the neck of the same color. In the earlier stages it has an orange cast. It is about two inches in length and is but thinly covered with hair. On

being disturbed this larva has a curious habit of clinging on with its legs in the middle of the body and rearing up with both ends.

The red humped caterpillar is somewhat shorter, of a dark color striped with very fine red lines, and it has a pronounced red hump upon the back. See Fig. 5.

Food Plants. While apple foliage is the favorite food of these insects most other fruit and many shade trees, including elm and birch are attacked.

Control. The feeding by these insects comes rather late in the season, and serious attacks require special spraying with arsenicals. In young orchards slight infestations may be handled by gathering up the groups of larvae into pails containing kerosene.



Fig. 29.—Fall Webworms at Work.
Courtesy, U. S. Bureau of Entomology.

The caterpillars are very hairy, about an inch long, of a general dark color with yellowish markings. See Fig. 30.

Food Plant. Elm, willow, apple, cherry and poplar are among the chief food plants of the webworms.

Control. A mid-summer spraying with arsenate of lead is the most feasible means of controlling this species.

Pine and Larch Sawflies

A curious group of insects belonging to the wasp and bee order, are called sawflies from the manner in which the adult saws a slit in the bark or stem in which she deposits eggs. The larvae of many of these sawflies resemble caterpillars in appearance and habits, and several are very voracious leaf eaters.

The Larch Sawfly (*Nematus erichsoni* Hartig) Wherever there is a considerable stand of larch, or tamarack, the results of the

work of this species is manifested by dead tops of some of the trees. Most serious infestations observed by the writer in Vermont have been in Essex County. The insect is of widespread distribution, however, and in some sections of the country has practically wiped out large areas of larch.

The full grown larva is about an inch long and is of a bluish gray color. It is to be found upon the trees during midsummer, and at the close of the feeding period goes into the debris at the top of the ground and pupates in a tough cocoon. In this condition it remains until spring when the adult sawflies emerge.

LeConte's Sawfly (*Lophyrus leconti* Fitch) The larva of this species attacks pine foliage and sometimes does considerable damage, especially in young plantations.

It is of a yellowish color with four rows of black dashes along its back and sides. The head is almost a vermillion hue, and like the others in this group, it is hairless. It forms a cocoon, after attaining its growth, pupates, and the bee-like adult emerges. The first of the brood mate and deposit eggs from which a second brood appears late in the season. Winter is spent in the pupa stage.

Abbott's Sawfly (*Lophyrus abbotii* Leach) This species is similar in habits to the LeConte's sawfly, but is somewhat lighter in body color and its head is black. It feeds on both hard and white pine.

There are several other species of lesser importance to us since they feed on the hard pines.

Control. Control of these species of sawflies is rather difficult, and probably is best accomplished in the case of small trees by breaking off the branches upon which the groups are feeding and putting them into pails of oil. They are gregarious and cluster closely together.



Fig. 30.—Full Grown Fall Webworms.
Courtesy U. S. Bureau of Entomology.



Fig. 32.—Work of Yellow-necked and Red-humped Caterpillars. Original.

Spraying with heavy dosages of arsenate of lead to which is added a spreader or sticker of soap or casein, is effective and a contact insecticide may be used to some advantage where the bunches of caterpillars can be picked out and shot at with a compressed air sprayer, or where larvae are congregated on the tree trunks.

The Alder Flea Beetle

(*Haltica bimarginata* Say)

An insect of slight economic consequence, but one which sometimes causes much alarmed inquiry is the alder flea beetle. Large patches of alders may be turned brown and practically defoliated by the larvae of this species. These grubs are black or very dark brown, and, when full grown, are about three eighths of an inch long. The adult is one of the steel blue, shiny beetles which have the characteristic flea-like jumping abilities from which their name is derived. Defoliation occurs in late summer.

Should control measures be necessary in parks or private grounds a liberal spraying with an arsenical when the larvae begin to appear would undoubtedly protect the foliage.

The Cherry Tent Maker

(*Archips cerasivorana* Fitch)

Another insect the work of which is more conspicuous than important is the cherry tent maker or ugly-nest tortricid. The larvae are slim, naked, yellow caterpillars which spin white webs over the wild cherry bushes, and as these are generally most plentiful along the roadsides, heavy infestations of this species often cause people to believe that some new, destructive pest has arrived.

The adults are small reddish moths the females of which deposit their eggs in masses upon the food plant.

Although other bushes and plants may be gathered up into



Fig. 31.—Yellow-necked Caterpillars.
Courtesy Conn. Agricultural Experiment Sta.

the tents or webs of the larvae, cherry is the only food plant. Choke cherry appears to be the favorite, though all varieties, including the cultivated trees, may be attacked.

The Hickory Tiger Moth

(*Halisidota caryae* Harr.)

General. The bushy, black and white caterpillar of this species sometimes runs riot over a great many varieties of trees, during several successive seasons; then not a single specimen may be observed for a period of years.

The adult, which is a speckled, yellow moth with a wing expanse of about an inch and a half deposits her eggs in masses of several hundred upon the leaves early in summer. The caterpillars hatching from a mass of eggs feed in a group until nearly grown, and frequently may be found stringing down from the branches upon silken threads. When full grown the larva is about an inch long, covered thickly with long black and white hairs, and having two long black pencils of hair projecting from the back near each end. See Fig. 34.

The larvae spin gray hairy cocoons under loose stones, lumber etc. These cause a very irritating rash if brought in contact with the human skin, as do, to a lesser degree, the full grown caterpillars.

Food Plant. While butternut seems to be the prime favorite, apple foliage is severely attacked when these caterpillars are plentiful, and a great many other trees serve as food plants.

These caterpillars feed somewhat later than do the tent caterpillars, but spraying as for the gypsy moth or the other later feeding caterpillars serves to control them.

The Giant Silk Worms

Cocoons, adults and larvae of the several species of giant or American silkworms frequently are received for identification or are the basis of alarmed inquiry.

The cocoon of the cecropia moth (*Samia cecropia* Linn) is commonly found in winter attached to the twigs of apple, maple, cherry and, less frequently other hardwood trees. It is a reddish bag of coarse silk, three or four inches long and tapering at each end. Its whole length is fastened to the twig, and its fabric is very tough. From such a cocoon, barring parasitism or other mishap, emerges in spring our largest moth. It is of a general dark grayish brown color marked with deep red and sometimes has a wing expanse of as much



Fig. 33.—Cocoon of the Cecropia Moth. Original.

as six inches. The larva is a huge greenish caterpillar marked with highly colored tubercles.

Similar to the cecropia is the promethea moth which is somewhat smaller and feeds chiefly upon ash and cherry. Its cocoons swing by one end. The polyphemus and the large green luna moths also belong to this group and their larvae feed upon hardwood foliage, principally oak, maple and beech.

None of these species are of particular economic importance owing to the activity of natural enemies, especially birds for which they seem to be attractive morsels.

The sprays which are applied during the summer for more important leaf eating insects are protection against such of the larvae of these moths as may be present.

The Larch Case-Bearer

(*Coleophora laricella* Hbn.)

This species is aptly described by its name, for it feeds exclusively on larch and spends the greater part of its life in a case. It is known to have been in Vermont at least since 1912, but in general it has caused no noticeable damage during that time until 1924 and 1925. During these seasons the foliage was badly riddled by the case bearers soon after it had come out, and the trees were given a rusty and sickly appearance.

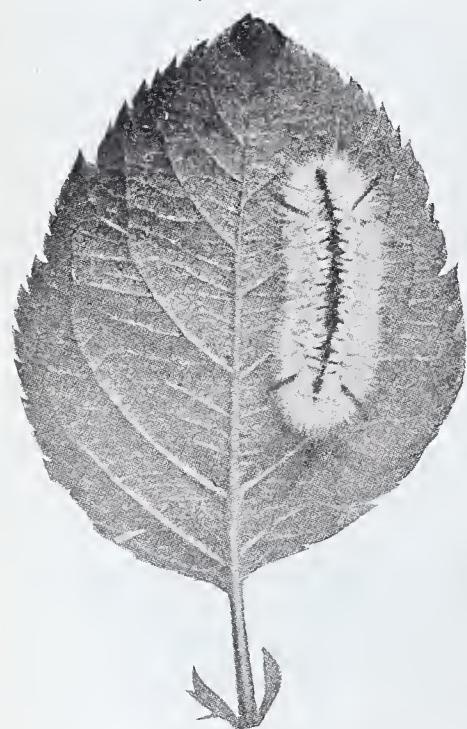


Fig. 34.—Hickory Tiger Caterpillar.
Courtesy Conn. Agricultural Experiment Station.

So widespread was the outbreak that few larches in the state escaped some injury. The species is of European origin.

The case-bearer spends the winter in its tiny case attached to a twig or the base of the needle whorl. This case has something the appearance of a tiny oat, not over a sixth of an inch long. It is really formed from a section of a larch needle. The larva within the case is less than an eighth of an inch long, smooth and of a dark color.

As soon as the leaves or needles begin to put out in the spring the larva commences feeding upon them. This it does by boring into the side of the leaf and then mining out the inner tissues as far as it can work without leaving its case behind. As it grows it expands its case by slitting it and inserting silken inserts or gores.

After feeding for a short time the larva attains its full growth about a fifth of an inch — and pupates within its case. Soon afterward the adult moths appear, though they are so small as to attract the attention only of those who are looking for them. They are silvery gray in color, and the wing expanse is not over a third of an inch.

These adults were observed in considerable numbers by the writer in mid-July and it is probable that their period of emergence covers several weeks around that time. After a few days eggs are deposited upon the leaves and the issuing larvae bore directly through the bottom of the egg shell into the leaves which they proceed to mine until September when, though instinct, they migrate from the foliage to the stems and twigs before it is time for the leaves to fall.

Protective measures against this pest are only applicable in case of shade or specially prized trees. Lime-sulphur as used for the dormant spray on fruit trees—See section on insecticides—is an effective remedy against the case bearer. It should be applied just before the foliage comes out in the spring.

The writer is indebted for facts as to the life history and habits of the case-bearer to Cornell University Agricultural Experiment Station Bulletin No. 322 by Prof. Glenn W. Herrick.

SUCKING INSECTS

Aphids

Plant lice, or aphids, constitute an important group of insects. There are many species, and no attempt can be made herein to consider them in detail. A few typical species are illustrative of various groups, attacking trees however.

The most common and characteristic work of the various kinds of aphids is the sucking out of the juices from the underside of the leaves, causing them to curl inward and, in severe cases of infestation, to dry up. Some work upon the bark or the newly forming twigs. Most conspicuous of these are woolly aphids which cover themselves with a white fluffy excretion. Still others cause the formation of galls and other abnormalities in the leaves and twigs.

The study of the aphids is complicated by the fact that many species require two or more different host plants and that their work takes very different forms on the different plants at different times of the year.

The Green Apple Aphid (*Aphis pomi* DeG.)

General. During the winter the tiny, black, shiny eggs of this aphid may be found upon the bark of last years new shoots. With the first real warm days of spring these eggs hatch and the nymphs collect and feed upon the expanding leaf tissues. Within a short time these wingless insects, which are all females, produce a new brood of living young, through a sort of budding process. These again are all females, but a few may be winged. Another reproduction occurs the

same way and later generations follow. The number of winged individuals increases with each brood until late in the fall when the true male and female adults are developed, and the eggs for the next season's brood are deposited. According to Quaintance and Baker in Farmers' Bulletin No. 1128 there may be as many as 17 broods in a summer.



Fig. 35.—Pine Bark Aphid. Courtesy Conn. Agricultural Experiment Sta.

The damage which they do is in the form of leaf injury through the sucking of the juice.



Fig. 36.—Work of Green Apple Aphid. Courtesy U. S. Bureau of Entomology.

The wingless forms are green with black legs and appendages, and the winged forms have black bodies and heads while the abdomen is green.

This species is found principally upon the apple tree.

The Woolly Apple Aphid (*Eriosoma lanigerum* Hausmann)

White, woolly masses on the twigs and about scars in the bark of apple trees late in the summer or fall manifest the presence of the woolly apple aphid. The insects themselves are small reddish plant lice which draw the sap from the bark, and work also upon the roots where they cause malformations.

This is one of the migrating species. Most of the eggs are deposited in the fall upon elm bark, and it is only after the winged forms have begun to appear in the summer that

they migrate to the apple. Quince and mountain ash are also given as food plants of the insect.

Woolly Alder Aphid: (*Prociphilus tessellatus* Fitch)

Of no economic consequence, but of considerable interest since it is so conspicuous along roadsides, is the alder blight or woolly aphid. Clusters of these insects beneath their white wool-like coatings may cover long stretches of the bark of alders late in the summer. This aphid is preyed upon by one of the very few carnivorous caterpillars, the larva of the little butterfly known as the Wanderer or the Harvester.

The same aphid attacks soft maple leaves and is then called the woolly maple aphid.

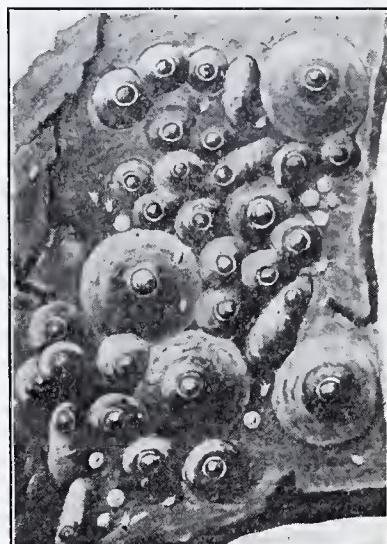


Fig. 37.—San Jose Scale (enlarged). Courtesy U. S. Bureau of Entomology.

Pine Bark Aphid (*Chermes pinicorticis* Fitch)



Fig. 38.—Work of the Oyster-shell Scale. Original.

White pines, particularly those used for ornamental purposes, are subject to attack by a small bark aphid which exudes a white substance similar to that of the woolly aphids before described. The smooth bark on the main trunk and on the larger branches seems most susceptible to attack, thus marring the appearance as well as drawing upon the vitality of the infested trees.

Spruce Gall Aphid (*Chermes abietis* Linn.)

Eggs of this species are laid at the bases of the newly developing spruce twigs. This starts the formations of tiny galls and as soon as the nymphs hatch they crawl into crevices which the growth of the galls

soon covers over. Late in the summer the galls crack open and liberate the aphids which have thus grown up within them. After a few days these aphids reach maturity, and eggs are deposited upon the needles. From these hatch what is known as the winter brood, only a small percentage of which probably survive cold weather. A sufficient number are alive in the spring, however, to deposit the eggs for the summer brood.

CONTROL OF APHIDS

Nicotine-sulphate has come to be the most popular spray or dust agent for the control of aphids. Whale oil soap, kerosene emulsion and the other contact insecticides may be used, but the nicotine solution is not only more effective and safer from the standpoint of foliage injury, but there is the great advantage that it may be used in combination with arsenate of lead or of lime and with lime-sulphur, as described in the section on insecticides.

The spray should be applied as soon as the appearance of the insects is noticed. In the case of the green apple aphid, first application should be combined with the delayed-dormant spray for scale, just as the leaf buds are opening. It must be directed so as to hit as many of the insects as possible.

Prof. Glen Herrick of the New York State Experiment Station at Geneva has recently discovered that lime-sulphur is an effective remedy for the spruce-gall aphid.

In some cases, such as that of the pine bark aphid, a strong head of water from a garden hose suffices to crush or drive the insects from the bark.

SCALE INSECTS

Of the same nature as aphids are the scale insects — minute sucking creatures which spend the greater part of their existence beneath waxy scale-like coverings formed by exudations from their bodies.

The Oyster-shell Scale (*Lepidosaphes ulmi* Linn.)

The species of most general distribution and attacking the greatest number of trees in Vermont undoubtedly is the oyster-shell scale, or apple-tree bark louse. The scales themselves resemble miniature oyster shells, not over an eighth of an inch long. Beneath these scales in winter are tiny white eggs which hatch about the first of June. The yellowish bodies of the newly hatched scale insects, resembling, to the naked eye, little particles of meal, may be seen for a few days crawling about on the fresh bark seeking likely points at which they may settle down. At length they insert sucking tubes into the tree and there remain — the female for the rest of her life, and the male until maturity when it appears on the wing as a very minute fly.

Damage arises from the drawing out of the juices from the bark, which, in severe infestations, becomes dry, cracks open and causes the

death of the branch or whole tree depending upon the extent to which the scales have encrusted the surface. See Fig. 38.

Food Plants. Apple, Maple, Poplar and Elm appear to be the favorite food plants but this scale may be found on many other trees.

Control. Lime-sulphur or the miscible oils are generally considered as the proper remedy for oyster-shell scale, and it is seldom that orchards well sprayed with these materials suffer from its attacks. However, in very serious infestations a more powerful spray is essential. Prof. W. C. O'Kane of New Hampshire recommends linseed oil emulsion for the purpose. It is made as follows: Dissolve one pound of finely flaked soap-in a gallon of boiling soft water. Remove this solution from the fire and add two gallons of raw linseed oil. Mix thoroughly by pumping back onto itself or rapidly turning from one pail to another until a creamy emulsion is formed. This makes a stock solution, and for the dormant spray against scale it should be diluted with water at the rate of one to nine.

A contact insecticide may be effectively applied to the trunks and branches when the young are first hatched.

The San Jose Scale (*Aspidiotus perniciosus* Comst.)

This is an imported species, capable, under favorable conditions, of causing more destructive work than any other scale insect in the state. It is not, however, generally distributed throughout the state, and is found in considerable quantity only in Windham and Chittenden counties.

The dormant spray of lime-sulphur or substitute material, such as the miscible or emulsified oils, is the proper measure of control.

This insect is treated at some length in Circular No. 5 of this Department copies of which are available upon request.

Other Scale Insects. There are a considerable number of other scale insects in the state, including the European fruit scale, the scurfy scale, the Putnam scale, one found in Shelburne, particularly destructive to basswood—*Aspidiotus osborni*—the Lecanium scales, some of which are about the size of split peas and are chiefly on the twigs, and the cottony maple scale which exudes a white, yeasty appearing substance. This is found largely on soft maples and woodbine.

BORING INSECTS

The Sugar-Maple Borer (*Glycobius speciosus* Say)

General. One of the most important tree insects in the state is the sugar maple borer. Its work is obvious to the most casual observation either in the sugar place or along the maple shaded street. If the loss which it causes in run of sap as well as in growth of board feet of lumber could be estimated the figure would be staggering.

Description and Seasonal History. The adult of this borer is a very pretty black and yellow beetle about an inch long. It appears in July or August and the female deposits eggs in the fresh bark of the maples. Shortly thereafter tiny grubs hatch out and begin feeding in the bark tissues. Not much damage is done, however, until the succeeding season when the borer, then in the most active period of its growth, works its wide galleries around through the outer sapwood. This work continues throughout the season, and the larva remains dormant in its burrow during the winter. Resuming its boring the second spring, it deviates its course sharply toward the heart of the tree for an inch or two then takes a short upward course, pupates there, and in due time emerges in the adult stage. The full grown larva is a whitish grub about two inches long. See Fig. 39.

Damage from the Borer. The work of this borer has two serious results. It kills the bark and sapwood adjacent to the galleries or burrows thus cutting down the food supply of the tree. Occasionally the galleries of two or more of these borers meet so that a tree is completely girdled. Furthermore, the base of the large branches seems to be a favorite point of infestation, and accounts for the great number of broken down limbs and ragged top systems of the sugar maples, especially in the case of street trees. And in addition to this direct damage, the wounds which the borer causes afford first class lodging places for various destructive fungi which may cause the complete dissolution of the tree.

Control. In the fall and spring the presence of the young borers is evident through slight cracks in the bark from which sap and fine borings or "sawdust" exude. By means of a sharp knife the borers may be followed up and killed, or they may be destroyed by means of a wire pushed into the extremities of the galleries.

Poisoned kerosene emulsion or miscible oil sprayed upon the bark late in the summer is said to be effective in killing the newly hatched larvae. The rule, as given in Farmers Bulletin No. 1169 of the U. S. Department of Agriculture, calls for 1 ounce of sodium arsenite for each gallon of water added to the stock solution to make the proper strength of dilution. In this case $5\frac{3}{4}$ ounces should be added to $6\frac{3}{4}$ gallons of the kerosene emulsion solution when ready for application. If miscible oils are used directions for dilution should be carefully followed and the poison added accordingly.

Undergrowth and thick stands of trees tend to discourage the presence of the beetle.

The Elm Borer

(*Saperda tridentata* Oliv.)

General. The presence of dead branches and dead patches of bark on elm trees frequently betokens the attack of the elm borer which, in the larval stage is a round headed grub, legless and rather flat. The adult is a dark beetle about half an inch in length, having on

its back and head fine red markings. Appearing during the summer the female beetle deposits eggs upon the bark and the issuing larvae soon work through to the cambium layer. Eating out galleries between the bark and the sapwood, they spread out over large sections of the tree, thus accounting for the loose patches of bark to be found on infested trunks and branches. The full grown grub, which is about an inch long, pupates under the bark and the new adults emerge in the spring.

Control. The immediate cutting of infested branches, or whole trees if necessary, constitutes about the only means of control. The poisoned spray described in connection with the sugar maple borer is impracticable in this case because the hatching period of the larvae covers a long period. If infested trees or branches are left the beetles will escape and fly to neighboring elms thus creating new and more intense infestations. This is particularly true in cities and villages where elms are used as shade trees.

The Locust Borer

(*Cyllene robiniae* Forst)

General. The ravages of this borer have unquestionably discouraged to a large degree the commercial planting and growing of a very valuable tree, the common locust, known as the black, yellow or white locust or acacia. The early breaking down of a high per-

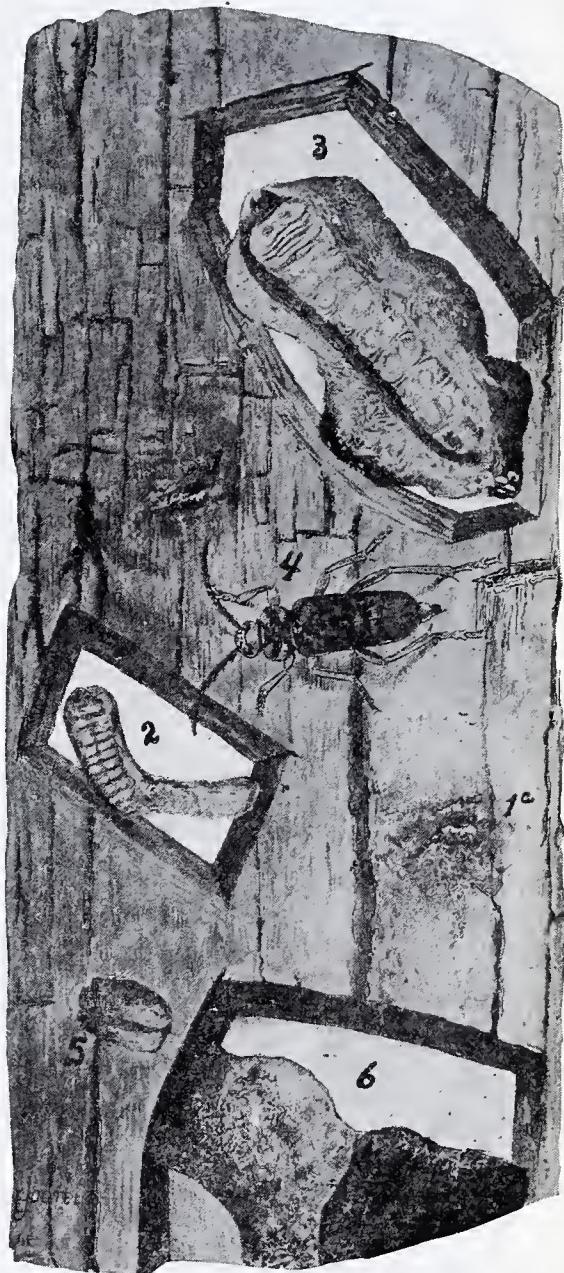


Fig. 39.—Sugar-maple borer and work: 1, Place where egg was laid 1a, another more than normally discolored and showing borings thrown out by borer; 2, grub in September from egg laid the same season; 3, grub nearly full grown; 4, beetle; 5, hole through which beetle escaped; 6, borings packed in burrow. (Felt).

centage of the young trees which spring up so prolifically about old seeding locusts is abundant proof of the severity of the work of the locust borer. The adult is one of the long horned beetles, some

what similar to the sugar maple borer in appearance, though smaller. It is given to frequenting goldenrod the presence of which, should, therefore, be discouraged in and about locust plantations.

Eggs are deposited in the bark during September, and the larvae hatch soon after. These begin working through the inner bark, become dormant during cold weather and resume operations in the spring working in the sapwood and also in the heart of the smaller branches. When full grown, in late summer, they pupate and a new crop of adults appear.

Control. Control is the same as that recommended for the Sugar Maple Borer, except that the spray should be applied in the spring just as the foliage begins to show green.

Allow no old badly infested trees to remain.

The Maple and Oak Twig Pruner

(*Elaphidion villosum* Fab.)

General. Infestations of this insect are quickly made evident by the falling to the ground of twigs and small branches, sometimes having a diameter as large as a half inch. This occurs in the late summer.

In these fallen portions can be found a slender, white, coarsely jointed grub, about three fourths of an inch long. This is the larva of a very dark colored beetle which deposited her eggs in the twig during the previous July. The feeding habits of the borer as it develops in the twig involve the girdling and breaking off of the twig.

Food Plant and Damage. Oak and maple are the principal sufferers from the attacks of this species. While the damage is not usually extremely serious, the tops may be trimmed back unduly by the

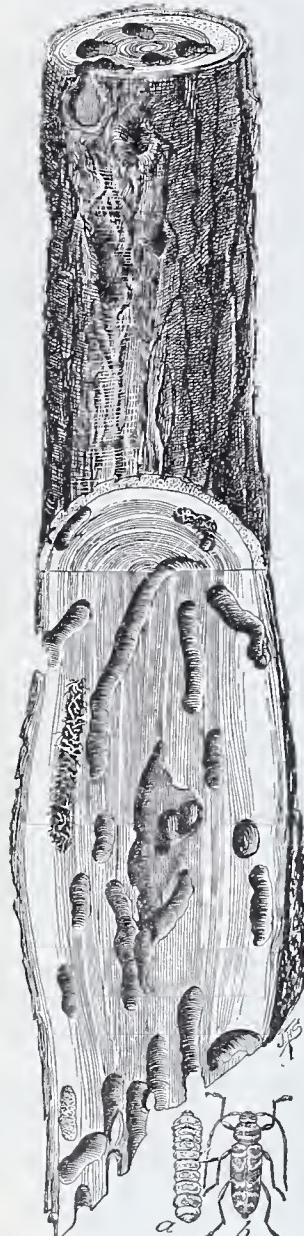


Fig. 40.—Section of trunk of locust tree, dying from injury by the locust borer. Shows burrows of borer in bark and wood; also the larva at a, and the beetle at b. (Webb). Courtesy U. S. Bureau of Entomology.

insects and the fallen branchlets constitute a nuisance in parks, cemeteries etc.

Since the larvae regularly spend the winter in the burrows which they have made in the twigs, the gathering up and burning of this debris constitutes the best protection against a similar outbreak on the succeeding season.

The White Pine Weevil

(*Pissodes strobi* Peck)

In almost any stand of white pine the "bayonetted" distortions in the main trunks caused by the work of the white pine weevil are evident in far too many trees.

General. The white pine weevil in the adult stage is a tiny snout-beetle, about a fourth of an inch long. It is brown with two whitish spots on the back. This beetle appears from its winter hiding place in the spring and as the new growth of the pines begins to appear it deposits its eggs in the topmost

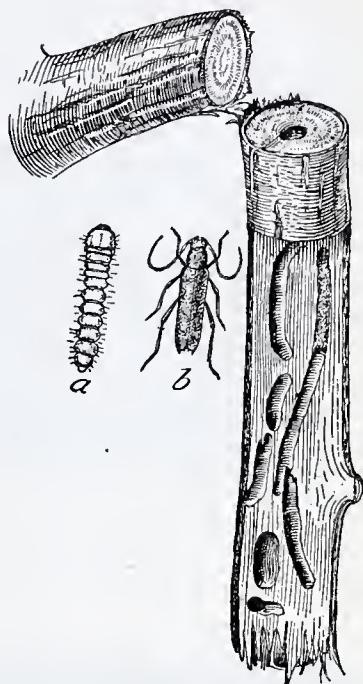


Fig. 41.—The Maple and Oak Twig pruner. a, Larva; b, Adult; pruned twig and larvae mines at right. (Webb).



Fig. 42.—Result of Work of White Pine Weevil.
Courtesy Connecticut Agricultural Experiment Station.

shoot or leader of such tree as it may select. The presence within the wood of the larvae or grubs which hatch from these eggs causes the leader to die, and though one of the laterals ultimately assumes an upright position in its place, there is always a crook at that point suggestive of the shank of a bayonet. Many trees suffer this malformation several times in the course of their growth.

Control. Control of this species lies in the close inspection of young plantations and stands of natural growth during July and August. Whenever any withering tip or leader is found it should be cut off and taken away to be burned or, better still, placed in a can the opening of which is covered by a screen with a mesh sufficiently fine to retain the adult weevils but large enough to allow the parasites to escape. Scattering pines in the vicinity also should be inspected so as to allow no neighboring breeding places for the insect.

Sprays appear to be the rather ineffective. Dr. W. E. Britton, State Entomologist of Connecticut, reports beneficial results in small plantations from the capturing of adult beetles in collecting nets. Each pine being shaken to start the beetles on the wing.

The Round Headed Apple Tree Borer

(*Saperda candida* Fabr.)

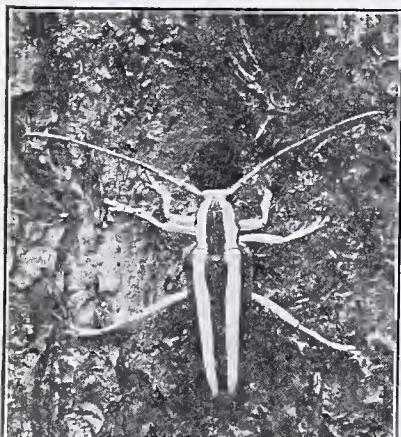


Fig. 43.—Adult roundheaded Apple-tree Borer, Just Emerged from exit hole in Bark.

General. This species, as the name implies, is a fruit tree pest though it also attacks several ornamental trees including shadbush and mountain ash. It is fairly typical of a considerable number of borers belonging to the same genus.

Seasonal History. Winter is spent in the larva stage in galleries close to the ground. Since the life cycle covers two, and in some cases three years, some of the larvae are ready to pupate and emerge as adults with the coming of warm weather; others are but partially grown and begin upon a season's destructive work.

The full grown larva is an inch long, whitish, with a widened thorax and no legs. The adult is a long beetle, brownish with two white stripes on its wing covers, head and thorax. It deposits its eggs in slits in the bark, and the issuing larvae work their way into the bark and, by late fall, into the sapwood.

Damage. The damage they do is familiar to most orchardists. The presence of the borers is usually first manifested by the reddish borings or "sawdust" hanging out in string-like masses. Many

young trees are annually killed by the work of this insect while others are seriously weakened and their growth is checked.

Cutting out the borers with a sharp knife, or "worming" the trees with a pointed wire are obvious methods of combatting this species. Injecting carbon bisulphide and plugging the entrance to the galleries is another means of control.

As a matter of prevention the tree trunks may be painted with one of the proprietary preparations designed for the purpose of protecting them from egg deposition by the adults. The dirt should be dug away a little from the base of the tree and the preparation should be applied from the ground to a height of a foot and a half.



Fig. 44.—Roundheaded Apple-tree Borer, Second Summer in tree. Courtesy U. S. Bureau of Entomology.

OTHER BORERS



Fig. 45.—Castings of Roundheaded Apple-tree Borer at base of Apple tree.
Courtesy U. S. Bureau of Entomology.

We have described a few species out of a tremendous host of insects which live within the bark and wood of the trees. The work of each, however, may be taken as fairly typical of a group, and the recommendations for control will generally be found applicable to similarly working species.

Most of the borers are the larvae of beetles. Some, however, are the young of moths. Such, for instance, is the leopard moth (*Zeuzera pyrina* Frb), an imported insect which has caused much damage to shade trees in the seaboard towns of southern New England and New

York and has been found near the Vermont line in eastern New York. The great carpenter worm (*Prionoxystus robiniae* Peck), a destructive borer in oak, maple and locust, is a moth in the adult stage.

Hosts of borers attack only dead or dying wood and it is unfortunately a fact that the weaker a tree becomes the more subject it is to the inroads of an ever increasing number of enemies.

